REMARKS

In the Office Action dated October 21, 2002, claims 3, 4 and 6 are rejected as indefinite under 35 U.S.C. § 112, and claims 1, 2, 4 and 5 stand rejected as unpatentable under 35 U.S.C. § 103(a) in view of combinations of references. Additionally, the specification is objected to due to the absence of section headings. A Substitute Specification is submitted with this response comprising the changes suggested by the Examiner. Applicant respectfully traverses the grounds of rejection of the claims for the following reasons.

Claims 3 and 6 are rejected under 35 U.S.C. § 112 due to the recitation of "least square basis" in these claims. "Least squares" is recognized by those skilled in the relevant art for a well-known statistical method for reducing errors in measurements. Attached to this response are two Webster's Dictionary portions (1990 and 1976) providing a readily available definition of the term "least squares," as that term is used in claims 3 and 6, and as described at page 3, line 10 and at page 6, line 18 of the specification as originally filed. Therefore, Applicant submits that the term "least square basis" as used in claims 3 and 6 is a definite term known and used by those skilled in the related art, and that claims 3 and 6 are properly worded.

Likewise, Applicant submits that the term "coherent" as recited in claims 4 and 6 is a definite term and one familiar to those skilled in the relevant art. Also, the term "coherent" as used in the context of the present invention is fully explained at page 3, lines 13-25 and at pages 7-9 of the originally filed specification, where the term is described as being an indication of the signal to noise ratio of the output of each sensor. The specification at page 3, line 12 to page 4, line 2 explains "FOUR COMPONENT COHERENCY" relating to the comparison of the signal output of the sensors in terms that are understood by one of skill in the art. Attached to this Response is a copy of page 440 from a 1976 Webster's dictionary defining the term "cohere" and "coherent." Applicant submits that the dictionary definition and the detailed explanation in the

specification provide one skilled in the art with sufficient clarity to understand the meaning of the term "coherence" as recited in claims 4 and 6.

Claim 1 stands rejected as obvious over Gragnolati et al. ('872) or Halladay et al. ('337) in view of Bednar ('362) or Jones, Jr. ('375). Applicant respectfully traverses this ground of rejection. The examiner has noted that neither the Gragnolati nor Halladay references teach or suggest the step of combining the outputs of the sensors to check that the sensor polarity is correct. The addition of the teachings of Bednar and Jones, Jr. does not cure this deficiency in the teachings of the two primary references.

Bednar and Jones, Jr. both check the outputs from individual sensors, e.g.: by comparison of each output with a reference signal in Bednar, and by tap-testing in Jones. Claim 1 specifically requires the outputs of the sensors to be combined, i.e. summing the outputs and checking that the sum equals zero. None of the applied references disclose or suggest this feature. Therefore claim 1 is submitted as allowable over the applied references.

Claims 4 and 5 are rejected as being obvious over Gragnolati or Halladay, in view of Fredriksson or Hall, Jr. The Examiner has noted that the primary references do not include the step of checking if the outputs are coherent, as recited in Applicant's claim 4, nor do they teach or suggest the step of checking the gains or sensitivities of the four channels. Applicant submits that neither the Fredriksson nor Hall, Jr. references teach the step of checking that the outputs from the sensors are coherent. The term "coherent" is defined in the specification as the normalized misfit of signal to noise comparison which tends toward zero when all the sensors are operating correctly, as explained at page 3, lines 12-25 of the specification. While Fredriksson or Hall may teach that checking for sensitivities of a geophone or sensor is important, neither of these references teach or suggest the specific step of checking that the outputs from the sensors are coherent, as recited in Applicant's claim 4. There is no teaching in

either base reference that the teachings of the secondary references can be combined with the disclosures of the base references to accomplish the step recited in Applicant's claim 4.

Likewise, neither the Fredriksson nor Hall references teach or suggest the step of checking the gains (or sensitivities) of the four channels <u>by taking a plurality of samples from the sensors, constructing a set of simultaneous equations from the samples, and solving the equations to determine the gains (or sensitivities) of the four channels,</u> as recited in claim 5 as presently amended. Therefore, claim 5, as amended, is submitted as allowable over the applied references.

Claims 2 and 4 stand rejected as obvious over Gragnolati or Halladay, in view of McCormick. However, the Examiner notes that neither of the primary references teaches or suggests the checking of sensitivities of each sensor upon checking that the outputs from the sensors are coherent, as recited in Applicant's claim 4. The Examiner also notes that neither Gragnolati nor Halladay teach or suggest the step of testing to ascertain if one of the sensors is not working, as recited in Applicant's claim 2.

Applicant submits that the McCormick reference cannot be combined with either of the two primary references to form Applicant's invention. McCormick relates to testing an entirely different type of array for a different purpose, i.e.: the malfunctioning geophones are identified so that they do not introduce errors into the total output signal from the array. The McCormick array is very large, an arragy of 32 sensors is mentioned, which all apparently have to be in the same orientation. Thus, the McCormick array doesn't appear to measure movement in three dimensions. McCormick also does not mention using the remaining operative sensors to compensate for the failed sensor. With the present invention, each time sample as it is collected allows for in situ testing of the geophones, with no extra equipment or interruption of recording necessary. Therefore, because of these major differences a skilled person would not think to combine McCormick with the Halladay or Gragnolati disclosures. For these reasons, Applicant submits that claims 2 and 4 are allowable over the applied references.

A Substitute Specification is submitted with this response, incorporating the changes suggested by the Examiner in paragraph No. 7 of the Office Action. The Substitute Specification includes a section titled "BRIEF DESCRIPTION OF THE DRAWINGS," which was inadvertently omitted from the originally filed specification. No new matter is introduced since the drawing figures were identified at pages 4, 9 and 11 of the originally filed specification. A document titled "Marked-Up Copy Showing Changes" sets forth the amendments to the claims and to the Substitute Specification pursuant to this response.

Applicant submits that claims 1-4 and 6, and claim 5 as presently amended, are in condition for allowance.

Favorable action is solicited.

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Respectfully submitted,

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Marked-Up Copy Showing Changes

In the Specification:

A Substituted Specification is being submitted incorporating section headings as requested by the Examiner. The following language has been added to pages 2 and 3 of the Substitute Specification:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow chart diagrammatically showing the steps of the present inventive method;

FIG. 2 is a display of data representing a typical microseismic event;

FIG. 3 is a display of the same data as FIG. 2, after the transformation of four sensor data to provide three orthogonal traces;

FIG. 4 is a display of the same data as FIG. 2, except that the vertical signal has been halved before the transformation was performed;

FIG. 5 is a display of data similar to that shown in FIG. 4, where the polarity of the vertical has been changed; and

FIG. 6 is a display of data showing application of the gain recovery procedure of the present invention.

Claim 5 has been amended as follows:

5. (amended) A method of using a seismic detector including four seismic sensors having axes which are in a substantially tetrahedral configuration, to detect and measure seismic activity, each of the sensors being in a respective signal channel, the method including the step of checking the gains (or sensitivities) of the four channels <u>by taking a plurality of samples from the sensors, constructing a set of simultaneous equations from the samples, and solving the equations to determine the gains (or sensitivities) of the four channels.</u>